

Flying into the Earth being oxidized fast at Mesoproterozoic era based on micrometeorites recovered from north China

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Micrometeorites provide a sample of the zodiacal dust cloud and give insights into the sources, flux and atmospheric entry processes of extraterrestrial material falling on Earth (Soens et al. 2022; Suttle et al. 2023). Completely melted particles are termed cosmic spherules and represent the largest fraction of extraterrestrial dust. Particles that have extensively melted and formed sub-spherical droplets owing to surface tension. Silicate-dominated particles are known as S-types, whilst those dominated by iron oxides and metal are known as I-types.

Most micrometeorites recovered from Mesoproterozoic ocean-basin in north China are nearly ideal sphere-shaped, which have globular shape with smooth surfaces. Exteriors of these particles show characteristic dendritic textures with morphologies of cruciform and cellular. Micrometeorites consist mainly of a Fe-C alloy core with discontinuous rim composed by dendritic wustite grains. Oxygen is not detected in Fe-C alloy, while oxygen, together with carbon and iron are major components of the rim. The Fe-C alloys in different particles are similar in composition. Carbon contents in Fe-C alloys of all the studied particles vary from 4.79 wt.% to 6.63 wt.% with Fe/C atomic ratios of 3.02-4.27.

The Fe-C alloy and carbon-bearing Fe-oxide micrometeorites recovered from the Mesoproterozoic ocean basin in north China are consistent with I-type micrometeorites based upon their small particle sizes, the retention of characteristic quenched dendritic textures, the preservation of intact Fe-C alloy beads in most particle, their high-temperature oxidized mineralogy following Genge et al. (2017). The Fe-C alloy observed in the studied I-type micrometeorites might be formed by a process of initial metal segregation due to pyrolysis of carbon in a carbonaceous chondritic parent body or in comets during atmospheric entry that results in the formation of a Fe-C alloy. This stage is followed by the ejection of a metallic bead which then undergoes extreme heating and oxidation during its atmospheric entry resulting in the formation of a Fe-C alloy and carbon-bearing FeO spherule.

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References: Genge MJ et al (2008) Meteor Planet Sci 43, 497–515; Genge MJ et al (2017) GCA 218, 167–200; Soens B et al (2022) GCA 325, 106–128; Suttle MD et al (2023) GCA 355, 75–88.

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